NCCOS NOAA NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE
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Aquatic Invasive Species*: Early Detection, Warning and Information

Invasive species affect all regions of the United States and every nation in the world. Society pays a great price for invasive species – costs measured in billions of dollars, unemployment rates, damaged goods and equipment, power failures, food and water shortages, environmental degradation, increased disease epidemics, and even lost lives. Stimulated by the rapid global expansion of trade, transport, and travel, invasive species and their costs to society are increasing at an alarming rate. These biological invasions can lead to native species and biological diversity loss at a rate second only to habitat destruction. Some of the most serious and costly invaders include diseases (e.g., West Nile virus and fish whirling disease), agricultural pests (e.g., African honey bees and Mediterranean fruit flies), and a host of relatively innocuous species whose sheer numbers overwhelm ecosystems (e.g., purple loosestrife, zebra mussels, European green crabs, and feral pigs).

Barriers to Early Detection

Controlling invasive species is difficult because scientists know little about when new aquatic invaders reach our waters. In only a few dozen U.S. locations, long-term biological monitoring has been conducted at intervals that are frequent enough to allow for early detection of aquatic alien species. These data are not yet linked by a computerized, searchable database that can produce comprehensive maps. In fact, most of the data are not in standard, consistent formats that would allow for them to be easily linked into a common data warehouse.

In addition, virtually no mechanisms exist that allow the public to report an unusual species, taxonomists to verify its identification, or managers to be alerted. Finally, few reliable inventories exist that identify the known alien species in U.S. and Canadian waters. But managers need to know when a new species reaches their region so they can decide whether to implement a mitigation plan, work to exterminate the species, or take no action at all.

Introduced zebra mussels impact U.S. and Canadian aquatic ecosystems. Photo: NOAA GLERL

Developing a Unified Response

NOAA, the U.S. Geological Survey (USGS), and the Smithsonian Environmental Research Center (SERC) have agreed to collaborate to make invasive species information more accessible. They are working to link their own invasive species information databases, and help link other public and private databases into a unified network. Their efforts will result in a single web portal that will allow users to search all the databases and download the data free-of-charge. Using the network, managers will be able to detect alien species before they spread beyond the point of initial introduction, and assess the risks posed by the new aquatic invader.

In 2003, portions of the program were initiated via the Hawaiian Pilot Project. In 2004, other regional data will be added to the Hawaiian pilot project to build a distributed network, and this information will be made available on the Internet. A comprehensive U.S. and Canadian aquatic species network should be operational within five years.

The multi-agency program has five components:

- an **inventory of aquatic species** known to reside in the U.S. and Canada against which potentially new species can be compared;
- a **reporting, species verification and warning system** to alert regional managers;

*An alien or nonindigenous species is a nonnative species that has been introduced, intentionally or unintentionally, to a region. It has established reproducing populations that flourish for a while in relatively restricted coastal areas, and then die out. Invasive species are thriving alien populations that expand their ranges with generally increasing ecological, environmental, economic, or human health consequences.

European green crabs invaded the U.S. East Coast in the 1800s and the West Coast in the 1980s. Photo: SERC

- an **aquatic species information network** with search and mapping capabilities;
- **risk assessments** predicting the likelihood of an alien species becoming invasive that are based on detailed species information sheets; and
- **monitoring for the early detection** of alien species to fill information gaps.

An Inventory of Aquatic Species

NOAA, USGS and SERC are developing an official, up-to-date inventory of all native and alien aquatic species by location that will help determine if a reported species is new to a region or already residing there. Other public and private partners are contributing to the inventory, assuring that it will be reliable and well-maintained. One major contributor, the American Fisheries Society, has provided use of its volumes that identify the aquatic invertebrates and fishes of North America. Also, the Bishop Museum in Hawaii provided a species list for the Hawaiian Pilot project. The list is currently in review by taxonomic experts.

A Reporting, Verification and Warning System

Using a reporting and species verification system, the public will be able to provide valuable information for aquatic areas not being monitored. Taxonomists will verify identifications, and specimens of newly found species will be stored in museums. Resource managers would automatically receive alerts if new species are found in their region. Public and private organizations are joining this effort. For instance, the Marina Operators Association of America, West Marine, and The Nature Conservancy are developing an early detection system that marina operators and their customers can use to help stop the transport of invasive species. The system will be introduced in Texas in 2004. Also, the Reef Environmental Education Foundation and its member SCUBA divers who survey marine life, including invasive species, have agreed to share their data.

An Aquatic Species Information Network

NOAA, USGS, and SERC maintain databases with rich biological survey and monitoring information that cover coral reefs in the Pacific and Caribbean, estuarine and marine fouling and soft sediment communities, marine and inland fish, and plankton. Through this project, these data resources will be widely available for the first time. Other federal, state/provincial, and local databases can be added to build a distributed information network. Currently, a Web site is being developed that will be a “one-stop” portal to the network. Web visitors will be able to compare their sightings of unusual species with the inventory list of known aquatic residents. The portal also will allow users to map species distributions and download data.

Risk Assessments for Biological Invasions

Not all alien species become invasive. Managers need to know, as soon as possible after an alien species is verified, detailed information about its physiological requirements, the likelihood that it could become invasive, and the possible associated impacts. To fulfill that need, NOAA, USGS and SERC support the National Estuarine and Marine Exotic Species Information System (NEMESIS), a database containing information on hundreds of species that is needed to prepare risk assessments. This information includes identification characteristics, photos, a species’ physiological/ecological requirements, its ranges, and the region to which it is endemic. The agencies will facilitate assessments that integrate this type of information and quantify the risks posed by invasion.

Monitoring to Detect Invasive Species Early

To identify alien species early, scientists need to periodically monitor the entire aquatic community (e.g., algae, higher plants, invertebrates, fish, and marine mammals), especially in more vulnerable areas like estuaries, seaports, coral reefs, and marine protected areas. In 2004, NOAA, USGS and SERC will develop monitoring protocols that will make the early detection of alien species easier. They also will initiate as many as five pilot monitoring projects in the U.S.

Beautiful but dangerous, lionfish are a recent East Coast invasive. Photo: NOAA/NCCOS

For more information, contact Dr. Donna Turgeon
National Centers for Coastal Ocean Science
1305 East-West Hwy Silver Spring, MD 20910 ph: (301) 713-3020 Donna.Turgeon@noaa.gov